**Supplementary Materials**

**Supplementary Table S1.** Body mass and interburst duration of 20 species from the literature and *Tribolium* *castaneum* from our study used for mass scaling of interburst duration after temperature correction to 25˚C (Figure 2; temperature effect calculated by using the regression coefficient of the measurement temperature for each species was removed before the mass scaling; shaded grey columns were used for mass scaling shown in Figure 2). Species are labelled (corresponding to the Figure 2) from 1-21, with *Tribolium castaneum* from our study labelled as 1 with other Coleoptera from literature as 2-10, Hymenoptera as 11, Blattodea as 12-17 and Orthoptera as 18-21.

| Order | Species | Label | Mass (M) | Log M | Measurement Temperature (Ta) | IB duration | Log IB duration | Ta effect at 25˚C | IB with Ta effect removed | Ref |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | G | G | ˚C | (seconds) | (seconds) |  |  |  |
| Coleoptera | *Tribolium castaneum* | 1 | 0.00178 | -2.75 | 25 | 21.8 | 1.34 | 0 | 1.34 | Our study |
| 0.00178 | -2.75 | 25 | 31.5 | 1.50 | 0 | 1.50 |
| *Zophosis punctata* | 2  | 0.070 | -1.15 | 25 | 488 | 2.69 | 0 | 2.69 | Duncan et al., 2002 |
| *Zophosis complanata* | 3 | 0.112 | -0.951 | 25 | 609 | 2.78 | 0 | 2.78 |
| *Pimelia canescens* | 4 | 0.312 | -0.506 | 25 | 188 | 2.27 | 0 | 2.27 |
| *Phorocantha spp* | 5 | 0.355 | -0.450 | 20 | 493 | 2.69 | 0.259 | 2.43 | Chappell and Rogowitz, 2000 |
| *Scarabaeus flavicornis* | 6 | 0.322 | -0.492 | 20 | 340 | 2.53 | 0.259 | 2.27 | Duncan and Byrne, 2000 |
| *Sisyphus fasiculatus* | 7 | 0.136 | -0.866 | 20 | 178 | 2.25 | 0.259 | 1.99 |
| *Scarabaeus rusticus* | 8 | 0.564 | -0.249 | 20 | 140 | 2.15 | 0.259 | 1.89 |
| *Anachalcos convexus* | 9 | 1.42 | 0.153 | 20 | 194 | 2.29 | 0.259 | 2.03 |
| *Circellium bacchus* | 10 | 7.29 | 0.862 | 20 | 2080 | 3.32 | 0.259 | 3.06 |
| Hymenoptera |  *Solenopsos invicta* | 11a: female | 0.00261 | -2.58 | 15 | 760 | 2.88 | 0.518 | 2.36 | Vogt and Appel, 2000 |
| 0.00251 | -2.60 | 20 | 262 | 2.42 | 0.259 | 2.16 |
| 0.00248 | -2.61 | 25 | 99.3 | 2.00 | 0 | 2.00 |
| 0.00259 | -2.59 | 30 | 34.6 | 1.54 | -0.259 | 1.80 |
| 11b: male | 0.00742 | -2.13 | 15 | 947 | 2.98 | 0.518 | 2.46 |
| 0.00744 | -2.13 | 20 | 327 | 2.52 | 0.259 | 2.26 |
| 0.00739 | -2.13 | 25 | 123 | 2.09 | 0 | 2.09 |
| 0.00741 | -2.13 | 30 | 30.2 | 1.48 | -0.259 | 1.74 |
| 11c: worker | 0.0145 | -1.84 | 15 | 345 | 2.54 | 0.518 | 2.02 |
| 0.0139 | -1.86 | 20 | 83.3 | 1.92 | 0.259 | 1.66 |
| 0.0142 | -1.85 | 25 | 17.6 | 1.25 | 0 | 1.25 |
| Blattodea | *Blatella germanica* | 12 | 0.0540 | -1.27 | 10 | 430 | 2.63 | 0.777 | 1.86 | Dingha et al., 2005 |
| 0.0488 | -1.31 | 301 | 2.48 | 1.70 |
| *Perisphaeria spp* | 13 | 0.315 | -0.502 | 20 | 315 | 2.50 | 0.259 | 2.24 | Marais and Chown, 2003 |
| *Nauphoeta cinerea* | 14 | 0.675 | -0.171 | 23 | 177 | 2.25 | 0.104 | 2.14 | Abbas et al., 2020 |
| *Periplaneta americana* | 15 | 1.1 | 0.0414 | 25 | 624 | 2.80 | 0 | 2.80 | Woodman et al., 2008 |
| *Aptera fusca* | 16 | 2.29 | 0.359 | 15 | 3670 | 3.56 | 0.517 | 3.05 | Groenewald et al., 2013 |
| 20 | 1981 | 3.30 | 0.259 | 3.04 |
| 25 | 963 | 2.98 | 0 | 2.98 |
| 30 | 385 | 2.59 | -0.259 | 2.84 |
| *Macropanesthia rhinoceros* | 17 | 26.5 | 1.42 | 20 | 600 | 2.78 | 0.259 | 2.52 | Woodman et al., 2007 |
| Orthoptera | *Paracinema tricolor* | 18 | 0.672 | -0.173 | 15 | 2724 | 3.44 | 0.518 | 2.92 | Groenewald et al., 2014 |
| *Tmethis pulchiripennis* | 19 | 0.51 | -0.292 | 25 | 414 | 2.62 | 0 | 2.62 | Huang et al., 2015 |
| *Ocneropsis bethlemita* | 20 | 0.96 | -0.0177 | 25 | 408 | 2.61 | 0 | 2.61 |
| *Ocneropsis lividipes* | 21 | 0.98 | -0.0088 | 25 | 366 | 2.56 | 0 | 2.56 |

**Supplementary Table S2.** Body mass and metabolic rate (both measured and Q10 corrected to 25˚C using a Q10 of 2) of species (17) showing CGE from the literature and *Tribolium* *castaneum* from our study used for allometric scaling of metabolic rate shown in Figure 3 (columns shaded grey were used for scaling relationship).

| Species | Family | Mass (M) | Metabolic rate (MR) | Measurement Temperature | MR (Q10) at 25˚C | Log M | Log MR | Reference |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | G | µl h-1 | ˚C | µl h-1 |  |  |  |
| *Pimelia grandis*Klug | Tenebrionidae | 2.10 | 535 | 25 | 535 | 0.322 | 2.73 | Duncan et al., 2002 |
| *Eloedes obscura* | Tenebrionidae | 1.26 | 270 | 22 | 332 | 0.0997 | 2.52 | Schilman et al., 2008 |
| *Trachyderma hispida* (Forskal) | Tenebrionidae | 1.03 | 292 | 25 | 292 | 0.0141 | 2.47 | Duncan et al., 2002 |
| *Helea waitei* | Tenebrionidae | 0.865 | 192 | 25 | 192 | -0.0630 | 2.28 | Duncan and Dickman, 2009 |
| *T. philistina* Riche & Sauley | Tenebrionidae | 0.859 | 240 | 25 | 240 | -0.0660 | 2.38 | Duncan et al., 2002 |
| *Zophobas morio* | Tenebrionidae | 0.580 | 178 | 23 | 204 | -0.237 | 2.31 | Abbas et al., 2020 |
| *Helea*sp. | Tenebrionidae | 0.481 | 102 | 25 | 102 | -0.318 | 2.01 | Duncan and Dickman, 2009 |
| *Akis goryi*Solier | Tenebrionidae | 0.478 | 92 | 25 | 92 | -0.321 | 1.96 | Duncan et al., 2002 |
| *Scaurus puncticollis*Solier | Tenebrionidae | 0.282 | 37 | 25 | 37 | -0.550 | 1.57 |
| *Pterohelaeus*sp. Brême | Tenebrionidae | 0.245 | 69 | 25 | 69 | -0.611 | 1.84 | Duncan and Dickman, 2001 |
| *Brises blairi*Carter | Tenebrionidae | 0.162 | 64 | 25 | 64 | -0.790 | 1.81 | Duncan and Dickman, 2009 |
| *Rhodnius prolixus* | Reduviidae | 0.115 | 19.7 | 25 | 19.7 | -0.940 | 1.30 | Rolandi et al., 2014 |
| *Tribolium castaneum* | Tenebrionidae | 0.00178 | 2.15 | 25 | 2.15 | -2.75 | 0.332 | Our study |
| *Crematogaster californica* | Formicidae | 0.0014 | 0.79 | 20 | 1.12 | -2.84 | 0.048 | Schilman et al., 2005  |
| *Dorourrmex insanus* | Formicidae | 0.00061 | 0.33 | 20 | 0.467 | -3.21 | -0.331 |
| *Linepethima humile* | Formicidae | 0.00046 | 0.55 | 20 | 0.778 | -3.34 | -0.109 |
| *Solenopsis xyloni* | Formicidae | 0.00041 | 0.32 | 20 | 0.453 | -3.38 | -0.344 |
| *Forelius mccooki* | Formicidae | 0.00027 | 0.26 | 20 | 0.368 | -3.56 | -0.436 |

**References**

**Abbas, W, Withers, PC, and Evans, TA** (2020) Water Costs of Gas Exchange by a Speckled Cockroach and a Darkling Beetle. *Insects* **11**, 632.

**Chappell, MA, and Rogowitz, GL** (2000) Mass, temperature and metabolic effects on discontinuous gas exchange cycles in *Eucalyptus*-boring beetles (Coleoptera: Cerambycidae). *Journal of Experimental Biology* **203**, 3809-3820.

**Dingha, BN, Appel, AG, and Eubanks, MD** (2005) Discontinuous carbon dioxide release in the German cockroach, *Blattella germanica* (Dictyoptera: Blattellidae), and its effect on respiratory transpiration. *Journal of Insect Physiology* **51**, 825-836.

**Duncan, FD, and Byrne, MJ** (2000) Discontinuous gas exchange in dung beetles: patterns and ecological implications. *Oecologia* **122**, 452-458.

**Duncan, FD, and Dickman, CR** (2001) Respiratory patterns and metabolism in tenebrionid and carabid beetles from the Simpson Desert, Australia. *Oecologia* **129**, 509-517.

**Duncan, FD, and Dickman, CR** (2009) Respiratory strategies of tenebrionid beetles in arid Australia: does physiology beget nocturnality? *Physiological Entomology* **34**, 52-60.

**Duncan, FD, Krasnov, B, and McMaster, M** (2002) Metabolic rate and respiratory gas-exchange patterns in tenebrionid beetles from the Negev Highlands, Israel. *Journal of Experimental Biology* **205**, 791-798.

**Groenewald, B, Chown, SL, and Terblanche, JS** (2014) A hierarchy of factors influence discontinuous gas exchange in the grasshopper *Paracinema tricolor* (Orthoptera: Acrididae). *Journal of Experimental Biology* **217**, 3407-3415.

**Groenewald, B, Bazelet, CS, Potter, CP, and Terblanche, JS** (2013) Gas exchange patterns and water loss rates in the Table Mountain cockroach, *Aptera fusca* (Blattodea: Blaberidae). *Journal of Experimental Biology* **216**, 3844-3853.

**Huang, S-P, Talal, S, Ayali, A, and Gefen, E** (2015) The effect of discontinuous gas exchange on respiratory water loss in grasshoppers (Orthoptera: Acrididae) varies across an aridity gradient. *Journal of Experimental Biology* **218**, 2510-2517.

**Marais, E, and Chown, SL** (2003) Repeatability of standard metabolic rate and gas exchange characteristics in a highly variable cockroach, *Perisphaeria* sp. *Journal of Experimental Biology* **206**, 4565-4574.

**Rolandi, C, Iglesias, MS, and Schilman, PE** (2014) Metabolism and water loss rate of the haematophagous insect *Rhodnius prolixus*: effect of starvation and temperature. *Journal of Experimental Biology* **217**, 4414-4422.

**Schilman, PE, Lighton, JRB, and Holway, DA** (2005) Respiratory and cuticular water loss in insects with continuous gas exchange: comparison across five ant species. *Journal of Insect Physiology* **51**, 1295-1305.

**Schilman, PE, Kaiser, A, and Lighton, JRB** (2008) Breathe softly, beetle: continuous gas exchange, water loss and the role of the subelytral space in the tenebrionid beetle, *Eleodes obscura*. *Journal of Insect Physiology* **54**, 192-203.

**Vogt, JT, and Appel, AG** (2000) Discontinuous gas exchange in the fire ant, *Solenopsos invicta* Buren: Caste differences and temperature effects. *Journal of Insect Physiology* **46**, 403-416.

**Woodman, JD, Cooper, PD, and Haritos, VS** (2007) Cyclic gas exchange in the giant burrowing cockroach, *Macropanesthia rhinoceros*: effect of oxygen tension and temperature. *Journal of Insect Physiology* **53**, 497-504.

**Woodman, JD, Cooper, PD, and Haritos, VS** (2008) Neural regulation of discontinuous gas exchange in *Periplaneta americana*. *Journal of Insect Physiology* **54**, 472-480.